REMARKS

In the Office action mailed April 7, 2005, the Examiner rejected claims 1-21 of the present application. By this Amendment, claims 1, 18, 20 and 21 have been amended.

Claim Rejections – 35 USC §112

Claims 20 and 21 were rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement. The Examiner states that the specification fails to teach that the substrate is movable in the liquid crystalline material.

The Applicant respectfully traverses this rejection of claims 20 and 21 for the following reasons. It is well known to those skilled in the chemical arts that many substances can exist in more that one state of matter that include a solid, a liquid and a gas. However, there are materials called liquid crystals that exist in a phase different from a solid phase and a liquid phase. Liquid crystals exist in a fluid phase that allows the liquid crystals to flow. The molecules in a solid are constrained to occupy only certain positions, also called positional order, and they are constrained in the ways they orient themselves with respect to one another, also called orientational order. When a solid melts to a liquid, both types of order are lost completely, that is the molecules tumble and move randomly. On the contrary, the nature of liquid crystal molecules allows them to freely move about in much the same fashion as in a liquid thus losing positional order, but the molecules tend to remain oriented in a certain direction thus retaining orientational order.

With the above-mentioned facts, it is apparent that if a material is positioned within the liquid crystal material, the material will be freely movable therein along with the liquid crystal molecules. Further, as is clearly stated throughout the original specification, the invention is configured such that the substrates, described in the embodiments as spherical substrates or microspheres, is inserted into the liquid crystal, making the spheres inherently movable within the liquid crystal. For example, as shown and described in Figs. 1B and 1C, the receptor provided on the substrate is inserted into the liquid crystal (see Brief Description of the Drawings and associated description of Fig. 1C on page 18, at lines 24-30). As noted with respect to this portion of the original specification, the "pathogen detection system 14a, comprising monospecific antibodies 14b embedded in biphilic, lyotropic liquid crystalline material 14c",

shows the substrate with ligand receptor in the liquid crystal material when positioned within the liquid crystalline material, the very nature of the liquid crystalline material enables movement of the substrate therein.

Further, the original specification provides a significant amount of further support for the claims as now presented. On page 19, lines 9-17, the invention is described wherein the binding of a ligand to a receptor associated with the spherical substrate, which is embedded in the liquid crystal, cause distortion which is "transmitted to the contiguous liquid crystal 14c". This clearly describes the substrates as being within the liquid crystalline material to cause the distortion presence of a ligand-receptor complex. Again, the nature of the liquid crystalline material enables movement of the receptor coated substrate through the material.

The Examiner's attention is also directed to page 22, lines 25-28, wherein an embodiment is described with the "receptor-ligand complex formation is mediated in the fluid phase or "flow through" phase, whereby the spheres and the liquid crystalline material are injected through an optical device." This embodiment makes it abundantly clear that the spheres are a fluid medium and freely movable therein. Further, the multiple examples of the invention, starting on page 26, line 13, through page 29, line 22, each describe the insertion of anti-body coated microspheres into a liquid crystalline material, wherein it is clear that the solution of microspheres is combined with the solution of liquid crystalline material and mixed. The mixing of two solutions as described clearly supports the claims as amended.

Based on the foregoing, it would be clear to one skilled in the art that when the microsphere (substrate), having a diameter of 1 μm, is inserted and mixed within the liquid crystal material, such microsphere would be capable of moving, thus movable, throughout the fluid phase of the liquid crystal material. With the liquid crystal material being fluid-like and nothing to impede, constrain or immobilize the substrate, it is inherent that the substrate would be free to move throughout the liquid crystal material. Therefore, Applicant respectfully requests withdrawal of the rejection under 35 USC §112 first paragraph.

The Examiner also rejected claims 1-18, under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant has amended claim 1 to more clearly define the present invention, and it is believed that independent claim 1, as well as dependent claims 2-17,

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and independent claim 18 now conform to the requirements set forth under 35 USC §112, second paragraph.

Claims 1-17 were also rejected under 35 USC §112, first paragraph, on the Examiner's position that the claimed invention is not supported by either a specific asserted utility or a well established utility. Applicant has amended claim 1 to more clearly define the present invention, and it is believed that independent claim 1, as well as dependent claims 2-17 now conform to the requirements set forth under 35 USC §112, first paragraph. Withdrawal of this rejection is respectfully requested.

Claim Rejections – 35 USC §101

Claims 1-17 were rejected under 35 USC §101 because the claimed invention is not supported by either a specific asserted utility or a well established utility. It is clear that independent claim 1, as well as dependent claims 2-17 now conform to the requirements set forth under 35 USC §101. More specifically, based on the Examiner's comments, it appears that claim 1 as previously set forth caused confusion relating to the language "a ligand" and "at least one ligand." This language has now been clarified in claim 1 as amended, and it is believed that this rejection should now be withdrawn.

Double Patenting

Claims 1-6, 9-11, and 15-17 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claim 5 of US Patent No. 6,171,802 in view of Holmgren et al. (US 5,681,571). The Examiner stated that although the claims are not identical, they are not patentably distinct from each other. In light of the claims as now amended, the application requests that this rejection be withdrawn.

As now claimed in Claim 1, the present invention is directed to a ligand detection device wherein a moveable substrate is positioned within a liquid crystalline materials and forms a receptor-ligand complex. The creation of the receptor-ligand complex creates a distortion in the liquid crystalline material contiguous to the complex and, therefore, a detectable change in the optical characteristics of the liquid crystalline material. The '802 patent does not teach such a device, and the teachings of Holmgren do not suggest these distinguishing characteristics in any

way. In fact, as taught in col. 12, lines 39-44, Holmgren teaches the determination of antibody levels with the use of standard solid phase enzyme-linked immunosorbent assay (ELISA) using polystyrene microwells. The use of polystyrene microwells in this ELISA method is not related to what is taught in the claimed invention, specifically independent claim 1 and those dependent upon it. Therefore, the combination of art cited by the Examiner simply would not result in the present invention as claimed. Withdrawal of this rejection is respectfully requested.

Claim Rejections – 35 USC §102

Claims 1-6, 8-11, and 15-17 were rejected under 35 USC §102(e) as being anticipated by Abbott (US 6,284,197). The Examiner stated that Abbott teaches a device and method for detecting analytes that comprises a substrate, a recognition moiety with a mesogenic layer/liquid crystals oriented on the surface, and an interface between the mesogenic layer and a member selected from the group consisting of gases, liquids, solids, and combinations thereof. Abbott is also stated to teach a method for detecting analytes comprising contacting a recognition moiety with the analyte, which causes the liquid crystals proximate to the recognition moiety to change from a first orientation to a second orientation.

This rejection is respectfully traversed in that the claims as now set forth clearly distinguish from Abbott. According to claim 1 as amended, the present invention is directed to a device comprising a substrate having at least one receptor to bind at least one ligand. The substrate is positioned within and moveable in a liquid crystalline material, such that when the receptor binds to the ligand, a receptor-ligand complex is formed. The complex formation alters the optical characteristics of the liquid crystal material and allows detection of the ligand. The prior art of Abbott simply does not relate to such a device, and instead is directed to a device which does not use a moveable substrate. Furthermore, Abbott does not teach that the receptor-ligand complex formation forms distortions in the contiguous bulk liquid crystalline material which alter the alignment of the liquid crystals, as is taught by the present invention. Rather, Abbott teaches a net difference in the liquid crystal alignment after ligand binds to a solid phase receptor at the surface interface of the stationary substrate and the liquid crystal material. Therefore, the present invention as now defined clearly distinguishes from Abbott and withdrawal of this rejection is respectfully requested.

Claim Rejections – 35 USC §103

Claims 12-14, 18, and 19 were rejected under 35 USC §103(a) as being unpatentable over Abbott et al. (US 6,284,197) further in view of Tarcha et al. (US 5,252,459). In forming the rejection, the Examiner stated that while Abbott fails to teach that the shape of the substrate is spherical, Tarcha teaches an assay method using solid phase/substrate materials such as chromatographic, bibulous, porous capillary material, fiberglass, cellulose or nylon pad, silicon particles, porous gels, polyacrylamide or polystyrene beads, etc. The Examiner stated that it would have been obvious to one of ordinary skill in the art to configure the shape of the substrate taught by Abbott into spherical shaped beads/ particles "as spherical shaped beads are well known in the art as solid phase supported by the teachings of Tarcha." Furthermore, the Examiner stated that one of ordinary skill in the art would find it obvious to use a substrate with a curved shape such as beads or particles.

Applicant respectfully requests reconsideration of the rejection, as the combination of prior art as cited by the Examiner simply does not teach or make obvious the present invention as now defined. Further, Applicant submits that there is no teaching or motivation to combine the spherical particles of Tarcha with the method of detection as taught by Abbott et al., even if the combination could be said to teach the present invention. Furthermore, it would not be obvious to one of ordinary skill in the art to make the combination. The present invention is directed to the detection of ligands with high sensitivity, therefore, only small quantities of ligand bound to the receptor are required to generate a signal. Tarcha et al. teach an indicator reagent, assay method and test kit, wherein an indicator reagent is formed by attaching an organic polymer particle to a binding member. The assay method yields results that can be detected by direct visual observation or instrumentation (i.e. color changes, etc.). There is no motivation to combine the test method/assay that produces a visual change in Tarcha et al. with the mesogenic layer of liquid crystals as taught by Abbott since the liquid crystal layer would prevent the visible results of the binding assay of Tarcha et al. from being observed.

Furthermore, while the indicator reagents of Tarcha et al. teach the use of spherical particles, Tarcha et al. is directed to a method of employing a solid phase material with a capture reagent (antibody) that is specific for a particular analyte (antigen) which is capable of binding to

a visible indicator reagent that is observable by direct visual observation or instrumentation. (i.e. color changes, etc.). As the Examiner has recognized, the prior art of Abbott does not teach in any way the use of spherical substrates positioned within a liquid crystalline material. The teachings of Tarcha do not relate to this deficiency of Abbott in any way. While the indicator reagents of Tarcha et al. teach the use of spherical particles, Tarcha et al. employs the use of a solid phase material for the detection of analytes in a binding assay that include a nylon pad for use in a flow-through assay device having one or more layers containing one or more of the assay reagents, a dipstick for a dip and read assay, a test strip for chromatographic or thin layer chromatographic techniques in which one or all of the reagents are contained in separate zones of a single strip of solid phase material. These solid phase materials as taught by Tarcha et al. are simply examples of stationary packing of materials capable of binding/detecting analytes that come in contact with the solid phase during an assay (col. 6, lines 20-59). It simply would not have been obvious to one skilled in the art to consider using material from this solid, stationary phase used in the binding assay of Tarcha et al., where detection of an analyte is purely at the stationary surface of the particles, which is then inserted and mixed into the bulk of a mesogenic layer of liquid crystalline material of Abbott for the detection of ligands as claimed in the present invention.

For reasons as set forth regarding the prior art, this device and method are clearly not taught or made obvious by the prior art. Favorable action on these claims is requested.

Conclusion

Prompt reconsideration of this application and allowance of the claims are requested. If the Examiner should have any question regarding this application or the amendment, a call to Applicant's attorney would be appreciated.

Respectfully submitted,

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By_____

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